

SCIENCE

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MODERN QUARRY REFUSE AND THE PALÆOLITHIC THEORY.

BY W. H. HOLMES.

ONE of the most important industries engaged in by the American aborigines in pre-Columbian and largely also in post-Columbian times was the search for and acquirement of the raw material for making implements and utensils of stone. Quarrying and mining were carried on in many places upon a vast scale, and in one case at least the work has been prosecuted without interruption down to the present time. The operations were, in most cases, carried on in remote or out of the way places, so that the sites remained for a long time undiscovered, and the industry and its accompanying arts have to a great extent escaped the attention of archaeologists. This work is now undergoing thorough investigation, and will henceforth take its place among the most important achievements of the native races, a work claiming precedence over nearly all others, lying as it does at the very threshold of art and constituting the foundations upon which the superstructure of human culture is built. Within the limits of the United States flint, chert, novaculite, quartz, quartzite, slate, argillite, jasper, pipestone, steatite, mica, and copper were most extensively sought.

The work in the quarries producing flakable varieties of stone was confined almost exclusively to obtaining and testing the raw material and to roughing out the tools and utensils to be made. The quarrying was accomplished mainly by the aid of stone, wood, and bone utensils, aided in some cases, perhaps, by fire. With these simple means the solid beds of rock were penetrated to depths often reaching twenty-five feet, and extensive areas were worked over, changing the appearance of valleys and remodeling hills and mountains. The extent of this work is in several cases so vast as to fill the beholder with astonishment. In one place in Arkansas it is estimated that upwards of 100,000 cubic yards of stone have been removed and worked over. The most notable features of these remarkable quarry sites are the innumerable pits and trenches and the heaps and ridges of excavated *débris* and refuse of manufacture surrounding them.

Many of the excavations have a new look, as if deserted but recently, whilst others are almost wholly obliterated as if by age. It is essential to observe, however, that where pits are sunk in solid rock and upon convex surfaces they fill very slowly, and that those in friable materials and upon slopes or concave surfaces fill rapidly. The oldest appearing may, therefore, be the youngest.

Several great quarries from which the flaked stone implements of the aborigines were derived have been examined. One of the most important is situated in the District of Columbia, two are in Ohio, two occur in Arkansas, one is in Pennsylvania, and another in the Indian Territory. These quarries cover areas varying from a few acres to several square miles in extent. They are pitted and trenched to various depths, and are thickly strewn with the *débris* of manufacture, including countless numbers of partially worked or incipient implements rejected on account of defects of texture and fracture resulting in eccentricities of shape. These rejects are extremely uniform in type in these quarries as well as elsewhere throughout the country, varying little save with variations in the nature and conditions of the raw material, the general result aimed at being always the same. It is therefore inadvisable in this brief sketch to describe the quarries separately or in great detail, as other more important matters must receive attention.

Rudely flaked stones are not confined to the great quarries; the raw material was worked wherever it was found scattered over the surface of the ground. The refuse deposits of village and lodge sites located conveniently to the stone-yielding districts also naturally contain many rejects of manufacture. Beyond these limits — the limits of the raw material — the rude specimens are rarely found. The main difference between the quarry shaping and the shaping done upon isolated shops and village and lodge sites is that upon the former, where the work was carried on extensively and consisted in securing the raw material in convenient form for transportation and trade, no specialization was undertaken, whereas upon ordinary shop and dwelling sites the full range of the roughing-out and finishing operations was sometimes conducted, the implement shaped being carried directly through from beginning to finish. In all cases the operations of shaping were, in the quarries, confined to free-hand percussion, further and more refined shaping being conducted elsewhere and employing the more delicate methods of indirect percussion and pressure.

The hammers used in breaking up the rock and in flaking are very numerous in most of the quarries; 500 examples, varying from 1 to 12 inches in diameter, were picked up in a few days' work in one of the great quarries of Arkansas. These hammers are generally of artificially discoid or globular forms. Such artificial forms of hammers are rare, however, in the boulder quarries of the east, since boulders of suitable form could be picked up on all hands and were discarded and fresh ones selected before the outline was perceptibly or seriously modified by use.

The true quarry, or more properly speaking the quarry-shop, product — that is to say, the articles made and carried away — may readily be determined in each case. This is rendered easy by the occurrence in the quarries of specimens broken at all stages of progress from the beginning to the end of the roughing-out process. The final quarry-shop form — and it must be especially noted that there was practically but one form — is naturally something beyond or higher than the most finished form found entire among the refuse. This form is necessarily, however, quite well represented by specimens broken at or near the final stages of the work. A most exhaustive examination of the great quarry sites has shown beyond the shadow of a doubt that this final form was almost exclusively a leaf-shaped blade, represented on the sites most accurately by broken pieces, all the acceptable blades having been carried away. This is the blade, varying in size and outline with the nature of the material and the particular end kept in view by the workmen, so often found in caches or hoardes distributed over the country and occurring in greater or less numbers on nearly every important village site. The place of this blade in the series of progressive stages of the manufacture of flaked tools is readily ascertained by a systematic study of the subject. It is the form through which nearly every common American variety of highly-developed flaked tool must pass before its final specialization is attempted. It is the blank form, ready for the finishing shops, tested in the quarry shops for quality of material and availability for further elaboration, and reduced in weight so far, and only so far, as to make transportation easy or profitable.

In most of the quarries a limited number of cores are found, from which small, generally very delicate, flakes were removed for use in the arts, and used, as a rule, apparently without much modification of shape. They were probably hafted for uses in which delicate manipulation was necessary. Their production was not an important feature of the quarry-shop work.

The question, very properly raised, as to what we really know of the nature and destination of the leading quarry-shop product, the blade or blank form, may be answered by asking another

question. Let us inquire whence came the millions of flaked implements of quartz, quartzite, chert, flint, slate, argillite, jasper, and novaculite that cover the hills and valleys of America, that occur upon every fishing-ground, shell bank, refuse heap, and village site occupied by the American aborigines, historic and prehistoric? They did not grow to be picked like ripe fruit from trees, nor could they have been dug up like potatoes from the ground. Where are the quarries and the shops from which the Indian secured his enormous supplies? For every million of spear and arrow points, knives, perforators, and scrapers—and there were many millions used by him—there are somewhere in America many times as many millions of broken and malformed failures of the very kind found in our quarries and shops, and where are they now but in these quarries and shops? The conclusion is inevitable. The finished and the unfinished (or rude) forms complement each other, and constitute a unit in art and in time. It was only our entire lack of knowledge of the subject that made other theories necessary or other conclusions possible.

These determinations with respect to the nature of the great body of the rudely-flaked stones of America may be expected to have some bearing upon the question of the occupation of this continent in glacial times by a people not yet advanced beyond the primal or palæolithic stage of culture, since the theory of that occupation is based upon the discovery of closely analogous objects in the gravels and elsewhere.

Before the refuse of quarrying and manufacture were studied and the true nature of the rudely-flaked forms determined, these objects had been quite extensively collected, and because of their rudeness and their supposed close resemblance to the early forms of European flaked-stone tools, had been classed as palæolithic and were so labelled in many museums, and as such found a place in the archæologic literature of both continents. It is now conceded by scientific men that this is all wrong, and that in the present state of our knowledge the separation of a single specimen from the main body of flaked stone art in America, save upon purely geologic evidence, is wholly unwarranted.

It is manifestly folly to attempt to select from the mass of these objects certain individual specimens to be arbitrarily called palæolithic. The selections made are quite as likely to be the youngest as the oldest. It is a well-established fact that many of the rudest flaked forms known, the simplest possible art shapes, are obtained from the shell-deposits and from the soapstone quarries of the eastern United States, and thus represent the most modern phases of neolithic Indian work in stone. Even if it be conceded for the sake of argument that there are multitudes of true palæolithic objects and implements scattered over the country, it is certain that up to the present date we have established no standards of form-comparison by means of which they can be detected.

Until geologic formations, glacial or otherwise, have furnished demonstrably palæolithic forms in sufficient numbers to warrant the establishment of types of implements peculiar to these formations, surface finds can be of no service whatever to advocates of the palæolithic idea.

The reported discovery of rude forms of implements in the gravels at Trenton, New Jersey, and subsequently at several points in the Mississippi Valley, led to the conclusion that palæolithic man dwelt here in gravel-forming time, and the theory that a well-differentiated period of rude flaked stone art precedes, in the normal order of development, a pecked and polished stone period, found a foothold in this country. Observations have multiplied, and the occurrence of flaked stones in the gravels is now supported by a large body of evidence. If even a small percentage of these observations are authentic, the evidence ought to be considered sufficient to settle *one* of the questions at issue, that of the *age* of occupation; for the finding of a very small number of works of art, either implements, shop rejects, or flakes—in fact, anything artificial—in the gravels by competent and reputable observers of geologic phenomena is all that is required to satisfy the scientific world of the presence of man of some grade of culture, primitive or otherwise, in gravel-forming times. To this conclusion there can be no serious objection. So far as I know, the possibility that there were glacial men, inter-glacial, and post-glacial men somewhere upon the continent is not seriously questioned by any one.

The infancy of the race may have been passed upon the eastern continent, but there is no sufficient reason why America may not have had a share in the nursing.

As I am not prepared to challenge the testimony brought forward by various collectors tending to establish the glacial age of human occupation, defective as much of that testimony seems to be, I will not raise the question of age, but proceed to consider the bearing of the evidence furnished by the quarry shops upon the question of the *grade* of culture indicated by the so-called gravel finds; the *age*, or period, of the occupation and the grade of culture attained being two very distinct things. Admitting for present convenience, then, that men dwelt in America in glacial times, I take up the question as to whether the culture of the hypothetical people, as indicated by the evidence furnished, is surely palæolithic. It has been repeatedly stated, and is still believed by many, that the gravel finds of the eastern United States closely resemble well-established European types of palæolithic implements. The critical observer will find, however, that this resemblance is superficial, and that they have a very much closer analogy with the rude quarry-shop rejects of America; and the latter are not really implements, and should not be called such any more than the faulty blocks of marble left in and about the quarries at Carrara should be classed as statuary. The distinctive feature of European palæolithic implements is, or ought to be, their evidence of specialization of form, their adaptation to definite use, indicated by what is known as secondary flaking; whereas these objects from the American gravels, with rare exceptions indeed, exhibit a total lack of this character. The semblance of specialization in thousands of the rude quarry rejects which have been worked hardly more than to test the flakability of the stone, not having begun to assume the contour and appearance of the implement contemplated by the workman, is more pronounced than in any of these gravel specimens. Appearance of specialization of form, may, therefore, signify nothing, and, if found, must not be taken alone as sufficient evidence that the object having it is a *bona fide* implement.

It should be further noted that not only are the gravel finds identical in form and material with the ordinary failures of the modern aborigines, but that they display the same mastery of shaping operations, beginning in the same way, progressing along the same lines, and ending at the same points, exhibiting no evidence of special adaptation to use in cutting, digging, picking, striking, or any other primitive manipulative act. It is also observed that none of these articles exhibit well-defined evidences of having been used, although it must be conceded that the rudest peoples made their tools for use; and it would appear that, as a rule, if they had been used they would bear very decided indications of that use, and would show a certain amount of specialization as a result of that use. Considering all of these points, I call attention to the extreme probability that these reputed gravel objects are not implements at all, but ordinary failures resulting from the manufacture of more highly specialized forms.

Again, it will be remembered that the gravel finds of the Pacific coast and some of those east of the mountains are neolithic, the forms being of a high grade technically and functionally, so that neolithic man is shown to have probably existed upon the continent whilst the eastern gravels were forming, and the condition of the art phenomena imply that he had dwelt here or somewhere east, west, north, or south, for a very long time, for thousands of years, if not for tens of thousands, and that, too, since he had passed the primal stages of art designated palæolithic.

How then is it to be proved that these particular rude forms, found so sparingly scattered through the gravels at Trenton and elsewhere, really represent and prove a palæolithic age, since they may simply be the rejects of manufacture left upon the banks of the glacial rivers by advanced neolithic men, who dwelt as intelligent men would upon the upper terraces out of reach of the icy floods? The argument that in these gravels rude forms only are found has no value whatsoever, since, as I have shown, it is the rule that where the raw material was sought beyond habitable sites no work save the roughing-out was undertaken, and no flaked forms save rude ones were left upon the ground. Because a few dozen specimens of rudely-flaked stones are found in the

gravels, and no highly specialized forms or other works of art are found with them, the conclusion is reached that they are palæolithic implements and that the art of the gravel-forming time was exclusively rude or palæolithic. Yet we may go down to the Potomac in the District of Columbia, or to the Washita in Arkansas, or to the Neosho in Indian Territory, and gather tons of similar rude forms made by our modern neolithic tribes, without finding a single specialized form or a single object of art aside from these rude forms. It is not my intention, however, to try to reconstruct the culture of that time, as I am not sure that there was any culture, but to point out the total inadequacy of the evidence upon which the theories of a particular culture are based.

The torrent-swept flood-plains of glacial times were hardly habitable places, and we do not know that there was game or fish to be sought there; but the great beds of boulders then and there accumulating furnished more or less raw material suitable for flaking, and if men, supposing they existed, coming down to the banks of the streams during periods of low water, essayed to rough-out their spear-points and knives in the usual fashion, the ever-recurring torrents would scatter the refuse about, leaving the coarse pieces in one eddy and whirling the lighter ones to other eddies below.

From this and from what has gone before it is clearly seen that these reputed gravel objects are probably not implements at all, and, whether they are or not, that they are as likely to have been left by neolithic as by palæolithic men.

So far have the advocates of a European classification for American phenomena gone beyond the limits of prudence in the treatment of these so-called palæolithic stones, that a radical change is demanded in the methods of classifying and labelling these objects in many of our museums; and it is to be lamented that a revision of all literature relating to the subject cannot be made in order to prevent the further spread of errors already too deeply rooted in the minds of the people, without offensive criticism of the work of living students.

This point may be illustrated by one example of the many that could be cited. The quartz objects from Minnesota, usually known as the Babbitt finds, of which so much has been said and written, prove on careful examination to be modern work-shop refuse settled into the talus of the glacial terrace. The slightly worked pieces heretofore collected and published as palæolithic implements almost without question on the part of archaeologists as to their origin or manner of occurrence, have no more intimate relation to the history of the glacial terraces than have the trees that grow upon their surface or the rodents that burrow in their sandy soil.

No rude flaked stone should be classified or labelled as an implement until it is proved to be an implement, and no specimen should be called palæolithic simply because it is rude or because it is found in the gravels, howsoever old. The attempt to classify these rude stones and to arrange them under types after the manner of European implements is sufficiently characterized, when it is stated that there is not in the museums of Europe or America a single piece of flaked stone found in place in the gravels of America and satisfactorily verified that can with absolute safety be classified as an implement at all.

If I should find a rude stone in place in the gravels—I have tried long in vain—I should permit myself to say only this, "Here is a work of art dating back to glacial times, I cannot tell whether it is a finished implement or not, as there are but slight signs of specialization and no indications of use, and I cannot tell whether it was made and left by a palæolithic or by a neolithic people, because neither of these peoples had a patent upon rude forms." Even if rude flaked stones are found in gravels ten times as old as the Trenton gravels, it must still be shown that they are not neolithic before it can be safely asserted that they are palæolithic, for the exclusively rude period of flaked art observed in Europe is so extraordinary that its repetition in other countries would approach the marvellous.

Little by little the advocates of a period of palæolithic culture in America have been forced to give up the idea that there is any other reliable test of the age of a culture than that furnished by geology; yet they are still going on utterly failing to recognize

the equally important fact that geologic phenomena cannot be safely observed save by geologists, and I may add with respect to gravel phenomena that the observations of geologists are not always infallible, the observations of geologists who have not especially studied gravels being of little greater weight than those of laymen. They must further concede that the finding of rude implements in the gravels or other ancient formations is not proof of a palæolithic age until it is sufficiently proved that the culture represented is exclusively rude culture, a point not attained, and I fear well nigh unattainable.

It follows from the above considerations that all speculations upon the culture status, ethnic relationships and geographic distribution of gravel-man in America based upon the discovery of rude forms of art are premature and misleading, and that, instead of being on firm ground and well advanced in respect to the antiquity and history of early man in America, we are not yet safely on the threshold of the study; and it is patent that until geologists take hold of the problem and prosecute the work, not as a side issue but as a great and leading question germane to the field of geologic research, little true progress will be made.

My explorations have been made with the greatest care and rarely without the aid and advice of some of the foremost geologists and anthropologists of the country. The conclusions reached have been freely discussed, and are generally approved by those familiar with the facts. These conclusions are subject to modification through the acquisition of new evidence derived from actual research in the field and in no other way.

In closing I would add that conservative students of American archæology will find it wise to consider well the following points relating to early man in America. 1. Is there a sufficiently full and sound body of evidence to demonstrate the presence of glacial man in America? 2. Is there satisfactory evidence that glacial man, if his existence be admitted upon the evidence available, was in any particular region in the palæolithic stage of culture? 3. Is there satisfactory evidence that the rude glacial finds in any case are implements at all? 4. Are deductions as to the habits, customs, arts, industries, institutions, and racial affinities of a people called for until at least one implement left by them is discovered, verified, and found to bear indisputable evidence of adaptation to or employment in some kind of use?

MODERN SYNTHETIC GEOMETRY VERSUS EUCLID.

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FOR more than two thousand years Euclid has held almost undisputed sway in the field of synthetic geometry. So strong a hold has it on school men that few American colleges dare offer anything else to freshmen. Is this because of tradition, or is there something in Euclid that makes it intrinsically better than anything mathematics has produced in modern times? To say that it holds its place merely because of tradition would probably be too severe a criticism, and would certainly call forth vigorous protest from its friends and defenders. To say that the wonderful advance in geometrical science in the last two hundred years has given us nothing superior to Euclid would be a doubtful statement, and almost an insult to the labors of such men as Monge, Poncelet, Carnot, Steiner, Von Staudt, and Cremona. No other branch of mathematics clings so tenaciously to that which is old, as geometry. In analysis, physics, mechanics, astronomy, everywhere but in geometry, the results and methods of modern thought are freely used, and no one doubts the propriety of their use. Why not take advantage of the same advances in geometry?

I have no quarrel with Euclid. It has been and is still a great factor in education. The severe training it gives in logical, clear thinking would be hard to equal. No doubt every student leaves Euclid with his mental powers greatly strengthened, and with increased ability to grapple with other studies and with the practical problems of life. Considered as to its educational value, but few objections can be urged against it. Mathematically considered, there are many things in favor of the modern synthetic geometry. Euclid is far more nearly a treatise on logic than on

mathematics. That a student succeeds well in Euclid does not argue that he will be a mathematician or even a lover of mathematics. Every teacher of experience knows how often his hopes, built on success in Euclid, have been dashed to the ground when the pupil began analysis. Euclid gives no hint of the mathematics which is to follow, and hence does not seem to fit in as an integral part of the science. Many of the proofs are long and tedious, with no hint whatever as to the method by which they were originated. The traditional limitations surrounding Euclid narrow the field of work by excluding almost all other mathematics, and thus must necessarily reach results that are special. The student who wishes to go on in mathematics finds himself almost totally unprepared for the next step.

Modern synthetic geometry meets all these criticisms. It is thoroughly mathematical, and the student who succeeds in it is assured of success in any branch of the science that he may undertake. Its steps are all logical, but logic is not emphasized as the end to be attained. It is constantly whetting the student's desire for mathematical study by giving him hints of that which is to follow. It also prepares thoroughly for trigonometry and analytical geometry. It is surrounded by no traditions, and so is free to use everything that serves its purpose. Its proofs are simple and direct, its results broad and general. Its symbolism and nomenclature are in harmony with mathematical science, and are at least two thousand years in advance of Euclid. It has a great fascination for the student, and classes are invariably enthusiastic over it. This year, as an experiment, one division of the freshman class in Indiana University studies the modern synthetic geometry, while the other divisions take Euclid. The modern synthetic class is by far the most enthusiastic, and gives strong evidence of the more rapid mental development.

The student who reads modern mathematical works must know the modern synthetic geometry. Modern writers appreciate its power, and use it freely. It is to be hoped that our American schools will give more attention to it. From a mathematical standpoint it is certainly desirable that it may soon entirely replace Euclid. The admirable elementary text-books of Dupuis of Toronto, Smith of Missouri, and Halsted of Texas, which have recently appeared, prove that the subject is growing in interest, and also make its general introduction more easy.

WEIGHTS AND MEASURES IN ENGLAND VERSUS THE DECIMAL AND METRIC SYSTEMS.

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It is impossible for a comparatively new country like America to conceive the mode by which the English conduct their internal commerce, and the difficulties which exist in trading not only with foreigners but between the different portions of the United Kingdom, owing to the versatility of the weights and measures used in conducting her business, the different values of the varied denominations within the United Kingdom, and the many quantities represented by the same denominations when applied to articles of daily commerce.

If the ingenuity of man had been strained to the utmost to introduce a system of weights and measures calculated to throw difficulties in the way of commercial progress, to perfect a system that no one man has thoroughly mastered, and to place irritating obstacles in the path of education of both pupil and teacher, that end has been thoroughly attained, and, strange to say, it is the system pursued in the educational establishments throughout the kingdom at the close of this nineteenth century, although most of the colonies have set the Mother Country a better example.

Can anything be more absurd than the following? We sell "pickled cod" by "the barrel," "trawled cod" so much "each," whilst "large hooked cod" are sold by "the score," and "crimped cod" "per pound," shrimps by "the stone," soles by "the pair," Dutch smelts by "the basket," and English smelts by "the hundred."

This is the Billingsgate system, but at Grimsby (another im-

portant fish market) quite a different style of weights and measures is made use of, and the sale of fish is very much by "the box" and "the last."

A customer once asked a Grimsby fish salesman to let him have a stone of oysters, the reply was "We don't sell oysters by weight, we sell them by measure." "Then let me have a yard," said the buyer. Butter in Ireland is sold by "the cask" and "the firkin;" in England by "the pound" of 16 ounces, by "the roll" of 24 ounces, "the stone," and the "hundred-weight," which is not 100 pounds but 112 pounds.

Analyzing the quantities of the various denominations only makes confusion doubly confounded.

What is a "load?" A load of straw is 1296 pounds, a load of old hay is 2016 pounds, and a load of new hay 2160 pounds; but my tables do not tell me at what age hay becomes old.

What is a "firkin?" A firkin of butter is 56 pounds, a firkin of soap 64 pounds, and a firkin of raisins 112 pounds. A "hogshead" of beer is 54 gallons, but a "hogshead" of wine is 63 gallons, a pipe of Marsala wine is 93 gallons, of Madeira 92 gallons, of Bucellas 117 gallons, a pipe of port 103 gallons, and a pipe of Teneriffe 100 gallons. Again, what is a stone? A "stone" weight of a living man is 14 pounds, but a "stone" weight of a dead ox is 8 pounds, a stone of cheese is 16 pounds, of glass 5 pounds, of hemp 32 pounds, a stone of flax at Belfast is 16½ pounds, but at Downpatrick 24 pounds, while a hundred-weight of pork is 8 pounds heavier at Belfast than it is at Cork—another injustice to Ireland.

England is slow to adopt new principles, but as more than 400 millions of people are using the metric system, surely it is time she took a step in that direction, a hint that probably may not be thrown away upon the grand American Republic.

In cataloguing the above absurdities of English measurement, I must not omit to inform you what quantities a barrel represents. A "barrel" of beef is 200 pounds; butter, 224 pounds; flour, 196 pounds; gunpowder, 100 pounds; soft soap, 256 pounds; beer, 36 gallons; tar, 26½ gallons; whilst a barrel of herrings is 500 herrings.

One example of the comparative merits of the existing system with the decimal system will suffice.

Reduce 987,654,321 inches into leagues. To arrive at this we must divide these figures by 12 to get them into feet, then divide the product by 3 to make yards of them, next by 5½ to find the number of poles, another division of the product by 40 exhibits the furlongs, then if the brain will stand it, for we have decimals in the quotient, we must divide by 8, which gives us the miles, and lastly by 3 to furnish the leagues, *quid erat demonstrandum*; and, if we have made no mistake, we have arrived at a satisfactory result.

To attain the same end by the decimal system, allowing the same number of denominations but each a decimal, no calculation is necessary, no sums to work out, but as there are six denominations, place the pointer on the left-hand side of the 6, the figures on the left of the pointer, viz., 987, show the number of leagues, whilst the figures on the right of the pointer furnish the fractions of a league, viz., 6 miles, 5 furlongs, 4 poles, 3 yards, 2 feet, and 1 inch.

Yet, can it be believed? the old system is taught in every school in England, and the cruelty inflicted upon the brains and the temper of the young, to say nothing of the loss of time and the cost, cannot fail to lodge a grave responsibility upon the legislature which permits such a condition of things to exist.

Nov. 4.

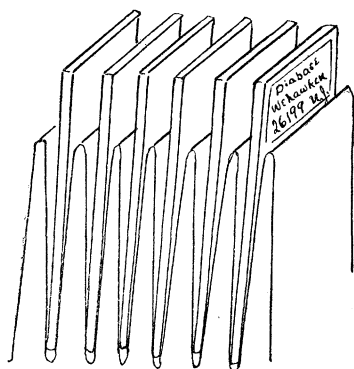
A CHEAP FORM OF BOX FOR MICROSCOPE SLIDES.

BY GEORGE P. MERRILL.

PRESUMABLY no one ever started out with making a collection of slides for the microscope but has wrestled long with the problem as to how they may best be taken care of. In the administrative work of this department the problem early became a serious one. For its satisfactory solution I am indebted to my brother, L. H. Merrill, then assisting me.

As it happened, we had in stock a number of paste-board boxes some 93 millimeters wide, 143 millimeters long, and 48 millimeters deep, all inside measurements. The dimensions of our standard slide are 48 x 28 millimeters. By means of two wooden partitions, some 3 millimeters thick, running lengthwise, each box was divided into three equal compartments, the partitions being held in place by glue reinforced by two small tacks at each end. Heavy Manilla wrapping paper, such as we also had in stock, was then cut into strips 25 millimeters wide and as long as the sheet of paper would allow, in this case about 7 feet. These strips were then bent into a series of folds, as shown in the accompanying illustration, the apices being rounded, not pinched flat. If carefully done, the folds when crowded gently together act as a spring. Two of these folded strips were then placed lengthwise in each compartment, and the slides introduced, standing on end, between the folds at the top. A box as thus prepared readily holds three rows of 50 slides in a row, or 150 altogether.

Each slide is separated from its neighbor in the same row by a double thickness of Manilla paper, which, owing to its manner of folding, acts as a spring, and avoids all possible danger of breakage. When all the compartments are filled, the space between the tops of the slides in any row is but about 2 millimeters; but there is, nevertheless, no difficulty in removing a slide or in getting at it to read the label without removal, since, owing to the yielding nature of the paper, the tops may be readily drawn apart. In this respect the box offers a great advantage over



those with rigid wooden compartments, such as are commonly in use. The first box was made merely as an experiment. It proved so satisfactory that, for the time being at least, it is the form adopted for storing the several thousand slides forming the museum collections.

I have attempted to show the arrangement as above described in the accompanying drawing. In reality the slides are held much more firmly than indicated, since the paper bulges and comes against both the front and back of the slides, the full length of the fold, instead of merely at the bottom. It will very likely strike the reader that a better material than paper might be found. I can only state that after considerable experimenting the paper was, all things considered, found most satisfactory.

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SPONTANEOUS COMBUSTION IN MINES.¹

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THE lecturer remarked that most of the difficulties of a mine could be overcome in certain well-known ways: water could be raised by pumping-engines; gas carried away by ventilation, and the danger obviated by safety lamps; but spontaneous combustion, in some cases, could not be prevented, and, when once begun, could not always be stopped, except by filling the pit with water.

¹ Summary of a lecture on the 10th of October last, at the Philosophical Hall, Leeds.

Spontaneous ignition of coal was well known to ship-owners and insurance companies, large cargoes of coal being especially liable to take fire upon long journeys. In the same way, a great heap of coal on the surface was liable to take fire, especially if it was small coal or slack. For that reason it was necessary in storing slack not to have the heaps too wide or deep. A heap ten feet deep might not fire, while a heap twenty feet deep of the same coal would be very liable to fire. A small heap of slack laid against the outside of a boiler-flue or steam-pipe would probably take fire in a short time. Heaps of slack and broken coal left in the mine were very liable to take fire, and much smaller quantities would fire in the mine than on the surface, because it was warmer underground, and the superincumbent strata upon the slack and broken coal prevent the heat from escaping. Spontaneous ignition was very frequent in the thick coal-miles of South Staffordshire, Warwickshire, and Leicestershire, and it was necessary that these pits should be watched every hour of the day and night lest a fire, having broken out, should obtain the mastery before it was discovered. If a fire was detected whilst yet smouldering, the heated material is dug out if possible and the place filled with sand. Sometimes the fire was extinguished by pumping water onto it. In some mines water was laid on at a high pressure for the purpose of throwing jets of water onto any fire that may occur. It was usual, however, in mines liable to spontaneous combustion, to separate the district containing the waste heaps of slack or broken coal from the rest of the mine by means of walls or dams of brick and clay and sand, so that the smouldering fire, producing carbonic acid gas, extinguishes itself by its own smoke. Sometimes an apparently solid mass of coal took fire. In this case the apparently solid coal has been cracked and crushed, and air has been able to enter into the cracks to support combustion. In mines liable to this species of accident, the manager has a very anxious time, and his deputies must unceasingly patrol the pit. Sometimes it was impossible to isolate a fire, owing to air drawing through cracks in the pillars of coal surrounding the fire, and the men were beaten back by the flames, and had to abandon the mine. The shafts were then partially filled and covered so as to exclude the air, and in the course of three or four months it generally happened that the fire was extinguished.

The cause of these fires was perhaps not entirely explained. It used to be supposed that the decomposition of the sulphuret of iron, called iron pyrites, produced heat sufficient. This idea was, however, now abandoned by the leading chemists who had studied the question. Sir Frederick Abel and Dr. Percy, in a report to the Royal Commission in 1875 on the "Spontaneous Combustion of Coal in Ships," suggested the decomposition of the coal as the probable cause. Professor Vivian B. Lewes, in 1892, contributed a paper to the Society of Arts, in which he stated, as the result of the work of Richters and himself, that newly-cut coal would absorb oxygen to the extent, in some cases, of three times its own volume. This oxygen produced a kind of slow combustion, and, where the heat could not escape, the temperature of the mine was raised to that of 800° to 900° F., and at this temperature, if there was any air near to the coal, it would take fire.

There were only two ways, apparently, of preventing this spontaneous combustion. One was to cool the heap by ventilation. But the ventilation to be efficient must be equal to that of a coal-heap on the surface, and it was known that a heap of small coal twenty feet thick and thirty or forty feet wide was very liable to take fire; therefore, if the heap of coal in a mine was to be cooled by ventilation, the ventilating roads would have to be not much more than fifteen feet apart, and a cool current of air through each. This, as a general rule, was impracticable; and therefore, as a general rule, the prevention of spontaneous ignition by ventilation was impracticable. The other method was to exclude the air from the mass of coal that was liable to fire by means of walls of soft clay or by walls of brick and mortar and sand, or solid pillars of coal. The portion of the mine so walled off might get very hot, raising the temperature of the mine ten or twenty degrees above the normal temperature of the earth; but it could not take fire if the air was excluded.

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[Numerous complaints reach us of delay in receiving "Science" through the mails. It appears that it frequently takes a week for the paper to reach Illinois, for instance. This is owing to the small allowance of funds to the New York Post-Office, which prevents the employment of a sufficient force and compels the present force to work in decidedly over-crowded quarters.]

THE PEDIGREE OF THE LETTER Y.

BY CANON ISAAC TAYLOR, LITT.D., YORK, ENGLAND.

It is commonly asserted that our letter *y* is the lineal descendant of the Roman *Y*, which in the time of Cicero was borrowed from the Greek alphabet to represent *upsilon* in the transliteration of Greek names. This, however, is a mistake, as will be seen by tracing the history of the letter. It is only when *y* is used, as the Romans used it, as a vowel to transliterate *upsilon* in loan-words (either direct from the Greek or indirectly through Latin or French), such as *hyperbola*, *hydrostatics*, *hypocrite*, *tyrant*, or *myrtle*, that our *y* represents the Roman *Y* and the Greek *upsilon*. In the great majority of cases the English *y* is a semi-consonant corresponding in value to the Continental *j*, as in *young*, *yea*, *year*, *Yenisei*, *Yakut*, which in German are spelt *jung*, *ja*, *jahr*, *Jenisei*, *Jakut*. Along with the other Roman letters, the letter *Y* was adopted by the Anglo-Saxons from the Latin alphabet, with a value approximating to that of *i*, and hence the *y* in Anglo Saxon words has usually become *i* in modern English, or has lapsed into the neutral vowel, as in the words, *fyr*, *fyst*, *hyd*, *hyf*, *brycg*, *ynce*, *hyll*, *flyht*, *yfel*, and *wyrm*, which are now written *fire*, *fist*, *hide*, *hive*, *bridge*, *inch*, *hill*, *flight*, *evil*, and *worm*. In fact, there is not a single lineal descendant of the Anglo-Saxon *y* now in existence. The letter *y* in modern English words is, curiously enough, not a *y* at all, but a lineal descendant of the Anglo-Saxon *g*, which was the Roman *G*, evolved by the Romans out of an earlier *C*. This Anglo-Saxon *g* split into two sounds, retaining the old hard sound before or after the back vowels *a*, *o*, and *u*, as in *go*, *dog*, *gold*, *gum*, while before or after the front vowels *e* and *i* it weakened into a palatal semi-vowel; the words *ge*, *gese*, *gea*, *git*, and *gear*, becoming *ye*, *yes*, *yea*, *yet*, and *year*. A symbol which has acquired two values is frequently differentiated into two forms, thus *i* and *j*, *u* and *v* have come to denote respectively the vocalic and semi-consonantal sounds of the same primitive symbol. This happened with the values of *g*. The Anglo-Saxon form *3* came to be appropriated for the weakened sound, and the Caroline or Continental form *g* was used for the original stopped sound. In Middle English MSS., we have the two forms side by side, written *3* and *g*. At the time of the invention of printing, this weakened *g*, written *3*, had become almost identical in form with *y*, and accordingly printers used *y* to express it, while in Scotland a *z* in black letter (*3*) was used for the weakened *g*, and in old Scotch books we find *yet* printed as *zit*, and *year* as *zeir*, not that these words were pronounced with a *z*, but *z* was used

for *3*, as *y* was in England; just we write *viz* for *videlicet*, where the *z* is not the sibilant, but merely an old ligature for *et*, *videlicet* being formerly written *videlic3*, in the same way as *libet* was written *lib3*. So also the final *y*, so common in English words, is really the descendant of the final *ig*, equally common in Anglo-Saxon; *many*, *busy*, *any*, *greedy*, *silly*, *honey*, *holy*, and *day* being the Anglo-Saxon words *manig*, *bysig*, *ænig*, *grædig*, *sælig*, *honig*, *halig*, and *dæg*. This final *y* is so common a termination in English that, owing to analogy, it has replaced the old termination *ie* in other words, as in *academy*, *anatomy*, *homily*, and *irony*, where it represents the Greek *ia*, or in *jolly* and *tardy*, where it represents the French *if*. In *by* and *my* it has been introduced from analogy with words such as *dry*, *fly*, *sky*, where the *y* is really the weakened *g*. It will be objected that in certain words, such as "young" and "yard," an Anglo-Saxon *g* has become *y* before back vowels, but this fact is really only a confirmation of the rule, as in such cases the front vowel which modified the *g* has been lost, "young" being from the Anglo-Saxon *geong*, and "yard" from *geard*.

In the neo-Latin languages the same weakening of *g* before front vowels took place, but duplicate forms of the letter not being available to denote the two sounds, *g* represents both sounds, as in the case of the Italian words *gente* and *gallo*, or the French *géant* and *gout*, or else the *g* was replaced by *j*, as in *jouir*, from the Latin *gaudere*.

INSTINCT.

BY C. F. AMERY.

It is now universally recognized that animals possess intelligence. The evidences on this head are too patent for dispute; but, like the guinea of the Primrose girls, it is supposed to be employed only in extraordinary emergencies. All the text-books on comparative psychology assume that all the ordinary pursuits of animals are instinctive, by which is implied automatic and mechanical; but whether instincts are to be regarded as impulses or as guides to action, or whether the activities are themselves instincts, is nowhere clearly defined in the text-books I have consulted. I purpose, in the present paper, to define the nature of instinct, and to indicate its place and the importance of its functions in the general economy of animal life.

The only satisfactory course of procedure is, first to collect and array the facts, and as man himself presents abundant illustration of all the psychological activities exercised in the animal kingdom, we cannot do better than examine the facts and study the nature and functions of instinct as exemplified in our own persons.

What then is instinct?

All the functions of the human organism and all the activities of life are classifiable under three heads — the mechanical, the reflex, and the intelligent.

The mechanical are the fundamental continuous processes of digestion, assimilation, circulation, secretion, and respiration. All these processes are performed unconsciously and involuntarily excepting respiration, which is performed sub-consciously and is to a small extent under the control of the will.

The reflex activities are automatic responses of the neuro-muscular organism to the stimulus sensations. They begin and end in the organism. In man, as in other animals, they are due to secretions in the system, to contact with external objects, or to special periodical or occasional conditions of the organism. They are all performed consciously by man, and are all susceptible of being brought more or less under the control of the will. The most common reflex activities are laughing, crying, sucking, masticating, swallowing, voiding the fœces and urine, coughing, sneezing, withdrawal from contact with objects, purposeless bodily exercise, etc. Laughing and crying may result from sensation, but they are sometimes reflex activities of the brain, originating in ideas.

Intelligent activities result from the perception of objects, their properties, and relations. Every effort for adjustment of the organism to external conditions apprehended through the senses is

intelligent. Touch is the connecting link between sensation and sense.

Instincts are not activities, but impulses to action. They are due to the sensations being transmitted from their several local seats to the brain, where they present themselves as cravings, desires, appetites, imperatively calling for relief. They prompt to two classes of activities, those which can be performed by reflex action of the organism, and those which require the adoption of intelligent means for their satisfaction. Hunger is a type of the latter, the impulse to void the feces and urine may be taken as a type of the former. Among the most important instincts are the craving for food, the sexual, and the maternal instincts.

Instinct impels to action, but does not guide to its performance. It appeals to the mind like a squalling infant to its parents. If reflex action will appease it, it is simply a function of the will; if intelligent measures are required, it is the function of the intellect to adopt them. I may emphasize here, as bearing on what I shall urge later, that the most important instincts originate in the local action of proper secretions, as the contents of stomach and bladder, the gastric juice, the spermatorrhoeal and lacteal secretions, etc., all provoking impulses essential to the preservation of the individual and the species; and no less important to man's intellectual development is the impulse to purposeless activity generated by the waste particles of the tissues on their way to the skin. Every psychological phenomenon has its physical basis, a self-evident proposition occasionally lost sight of in the discussion of instinct.

Up to this point it will be generally admitted that the vertebrate animals and higher insects are physiologically and psychologically close counterparts of man, the one essential difference being that their perceptions are all limited in range, while man's perceptions embrace the universe. The distinction appears to arise when we approach the subject of the inherited perceptions and working capacities. Many of the lower animals exhibit special inherited capacity involving clear perceptions such as man rarely exhibits without experience or instruction; and by almost common consent these special capacities and perceptions, although recognizedly the inheritance of the active intelligence of the species, are classed as "instincts." The classification which groups these psychological phenomena with impulses generated by secretions, is hardly a scientific one. Moreover, the accepted theory assumes that the species of so-called mental automatism exhibited, implies less intelligence than was displayed by the early parents of the stock in reaching the attained level of capacity, a view certainly not borne out by any degeneration of the brain; and, last, the advocates of the theory appear entirely to forget how much dexterity of brain and hand man has acquired by heredity. But before entering on this subject I want to make a few remarks on the function and importance of instinct in the economy of life.

Instinct is the schoolmaster of the intellect. Primitive man, looking around on his environment, would hardly have acquired a single perception of the properties and relations of objects, unless spurred to investigation by his instincts. The instinctive craving for daily food spurred his faculties to the discrimination of all the food substances presented to his senses. He soon acquired familiarity with the characters of every fruit, grain, root, etc., capable of appeasing his hunger, and with the characters and habits of all living creatures around him. In these matters he was fairly rivalled by the lower animals which, prompted by the same instinct of hunger and sense of danger, had their perceptive faculties equally aroused to the character of every thing that could be used as food by them, or that imperilled their lives. Man's hand was the wonderful organ which soon raised him above the intellectual level of the beasts; this, too, would have been useless to him but for the impulse to purposeless activity which besets him from childhood. Subject to this instinct he was, in common with his less-gifted fellow-creatures, under the imperative necessity of exercising every set of muscles and testing every organ in every direction of which it was capable of being used. In these exercises man at once became a being apart, by virtue of his hand. He was impelled to lay hold of every thing he saw, within the compass of his grasp, and whatever he laid

hold of aroused his perception of its properties. He hurled stones and wielded sticks, revelling in the mere enjoyment of his powers, until gradually he acquired that experience of the properties of sticks and stones which suggested their application to the ever-present necessity of providing food. It must not be supposed that he advanced to a single idea without experience. He must have experienced the force of a blow from stick or stone, perhaps many times, before he conceived the idea of utilizing them as weapons of offence or defence. Once started on his path of progress, his daily experience constantly added to his stock of perceptions of the properties, and later of the possible uses, to which he could apply the objects he actually handled. There came a time in the progress of the race when man learned to reason from the known to the unknown, but primitive man was slow in developing this faculty. As regards every thing which affects their personal preservation and food supply, all the evidences point to the conclusion that the perceptions and reasoning powers of other animals are as keen and sure as savage man's; but, wanting the hand and the accompanying wider range of perceptions, their progress was limited to a narrower field. Only one mammal, the beaver, has developed a high constructive capacity. Why is this?

Remembering what was above said about instincts originating in secretions, it suggests itself that the castor of the beaver may possibly furnish a special impulse to activity in a prescribed direction, but this is not necessary to explain the dam- and castle-building talent of the beaver. The materials used in construction were the waste products of his food which he had to manipulate under conditions which compelled his attention to such of their properties as he utilizes. By taking them to the mouth of his hole, and floating them off when the water was low, he dammed the stream and raised the water to his hole. In arranging them about his hole to make room temporarily, his perceptions were trained in the direction of castle-building. Given the beavers primitive habits and the suitable environment, the direction of his evolution was as much a matter of constitutional necessity as man's. Fewer faculties were called into requisition in his case, but these concentrated on special labors attained greater natural facility of application, this added facility becoming in time constitutional in the species.

The wonderful constructive powers of insects have been developed subject to the same law, but for the most part these creatures enjoy special facilities for the development of their special capacities. They not only have special instincts due to special secretions, but in these secretions they have the materials of construction. The thread of the spider and silkworm, the wax of the bee, the viscid, and other special secretions of a hundred other insects, are all materials which would not excite their attention if they existed apart from themselves, but being under the daily necessity of manipulating them and being under a constitutional necessity of manipulating them in certain ways determined by the structure of their brain and manipulating organs, the species is forced to a perception of the uses they subserve, and are educated by experience to the point of engaging in their manipulation intelligently and with design. And just as the hand has played an important part in the evolution of man's intellectual faculties, so have the special secretions and special organs of insects necessarily produced like results. Their field of performance is limited in direction, but within their prescribed limits it is not unreasonable to suppose that they surpass man in the clearness of their perceptions. Within the field of their special activities they do not reason, they know. They reason only in emergencies.

This brings us to the final point and apparently vast distinction between the achievements of men and insects; and the arguments which apply here will hold good in considering the special aptitudes of creatures in other classes. The insects have inherited aptitudes for performing their special tasks without experience or instruction, ergo, it is argued, they are automatic, instinctive.

First with regard to the term instinctive, let us repeat here, the impulses generated by their special secretions prompt in all cases to the voidance of these secretions, but they go no further; the application of the voided material or its mixture into mortar

as with the white ant and mud-wasp are the results of intelligent observation and experience.

But it has become automatic ! Brain and manipulating organs fulfil their allotted task without experience and instruction !

Here the parallelism with man is certainly no longer perfect; there is a divergence, but a divergence due only to the same laws acting on two sets of modified conditions. Man has developed by radiation in ever-widening circles and is still in course of an all-round development. The insect has developed along a narrow line and has reached the limit of his capacity, but that limit surpasses man's utmost attainments, both in clearness of perception without intellectual effort, and in facility of execution. The knowledge and capacity of execution gained by observation and experience have become constitutional. Man, in spite of the great breadth of his intellectual range, does occasionally reach something like the inherited clearness of perception and facility of execution of the insect, at special points of the circle; as, for example, in the inherited musical powers of a Mozart and other born composers, who have been capable of composing as automatically as the bee makes its cell; and I assume for both a similar intellectual gratification in the exercise of their powers. Look again at the born arithmeticians and mathematicians; or, again, at the achievements of a Siemens. Does any one suppose that these involve the intellectual labor performed by the average tyro struggling to overcome some petty difficulty? Great results have unquestionably been achieved by enforced attention and patient labor, but the greatest achievements arise by unconscious reflex action of the brain to the stimulus of inherited memories which evolves the idea before it even rises into consciousness. It is precisely this clearness of perception and facility of execution, recognized as genius in man, which characterize the special labors of insects and other of the lower animals in their special narrow fields. Further, all naturalists who have given close study to the hymenoptera, for instance, will, I think, support me in the conclusion that the automatic facility displayed in their special tasks is accompanied with intellectual resources which enable them to deal intelligently with emergencies which may arise in the course of their performance.

We may find a still closer parallelism between man and the lower animals in the matter both of inherited perceptions and capacities of performance on a lower intellectual plane, which being part of every man's experience, the relation of inherited to acquired ability will be the more readily appreciated. Every child knows intuitively that an apple is good to eat. On this point his perceptions are clear, his convictions not to be shaken. This is a familiar instance of inherited perception or brain memory. In fighting we have an illustration of muscle-memory. A fistic encounter calls forth as diversified and complicated a series of activities as almost any species of manual labor, but a ten-year-old boy of fighting stock will stand up to his first fight and play his part with a skill and address and promptitude such as he could not acquire in any industrial pursuit without considerable training.

These are only particular illustrations of a well-known general law. Any muscular or mental labor long persisted in is attended with a facility of execution which in time becomes constitutional in the race. Man is immeasurably removed from the lower animals by his wider range of perceptions and capacities, but we cannot form a better idea of the intellectual status of the lower animals, within their narrow limits, than by speculating on a future ideal stage of human evolution, when every child born into the world will, as his intellect unfolds, display, without instruction, the mathematical genius of a Euclid, the musical powers of a Mozart, the logical powers of a Bacon, and the comprehension of character of a Shakespeare.

THE DATE OF THE LAST GLACIAL EPOCH.

BY MAJOR-GENERAL I. C. COWELL, WINDSOR, ENGLAND.

Now that the untiring labors and vast research of such men as Professors Wright, Prestwich, and Emerson, Dr. Andrews, and Messrs. Gilbert and D. Mackintosh have resulted in such remarka-

ble coincidences as to the period of the termination of the last glacial epoch, England, as America, may well be congratulated upon such achievements by their men of science in that intensely interesting field of enquiry; but our satisfaction would be far from complete if we did not find confirmation of these results in those of astronomical discovery, which give evidence of that perfect harmony which has so long been sought for in vain by astronomers and geologists and by all those who have awaited the revelation which unquestioned facts have at last disclosed. These are to be found in the beautiful discovery of Major-General Drayson of the Royal Artillery (formerly professor of astronomy at the Royal Military Academy at Woolwich) of the second rotation of the earth, whose works, entitled "30,000 Years of the Earth's Past History" and "Untrodden Ground in Astronomy and Geology" (published by Chapman & Hall and by Paul, Trübner & Co. of London), afford the most striking testimony to the accuracy of the calculations of the gentlemen referred to.

In so short a notice as this it is only possible to give a general outline of the discovery, which has occupied nearly thirty years for its full development, resulting in the discovery that the glacial period, or, more properly speaking, periods, occupy about 20,000 years, whilst the last terminated about 6,000 years ago. This, however, is but one of the results of the discovery.

The earth has three principal movements, the first being its daily rotation, the second the annual revolution of the earth round the sun, and the third a slow second rotation of the earth which causes the half axes of daily rotation to trace cones during a period of about 31,600 years.

The second rotation, more accurately defined, consists in the pole of the heavens describing a circle round a point, which is ascertained to be situated six degrees distant from the pole of the ecliptic, having a right ascension of 270 degrees, and at an angular distance from the pole of the heavens of $29^{\circ} 25' 47''$, this angle depending upon the position of the centre of gravity of the earth, the earth being considered as a gyrating sphere, and so following the ordinary laws of gyration.

The two semi-axes of the earth by this movement describe cones, having their apices at the centre of gravity, which in the case of the earth nearly corresponds to the centre of the sphere. From the knowledge of this law, and from these data, the polar distance of a star can be at once calculated for more than a hundred years from one observation only, and to the decimal of a second of an arc, a result which hitherto could only be attained by constant observation and laborious calculations by the method adopted by astronomers in ignorance of the properties of this rotation.

The obliquity of the ecliptic can be ascertained for any time during the revolution of the poles, which are calculated to occupy 31,682 years in completing the circle. Hitherto the time supposed for the completion of this conical motion was about 25,000 years, during which period scarcely any variation occurred — so it was asserted — in the extent of the Arctic circles and tropics.

By a knowledge of the second rotation it is proved that a variation of twelve degrees in the extent of the Arctic Circle and tropics occurred not later than 13,500 B.C. The procession of the equinoxes is ascertained to be the result of this second rotation, and due to no other cause; and the rate of procession can be ascertained at any time, this, it may be mentioned, being proportionate to the sine of the obliquity of the ecliptic at the time indicated, in its every-varying amount from the minimum of $23^{\circ} 25' 47''$ to the maximum of $35^{\circ} 25' 47''$.

With such a difference, it follows that at the height of the glacial period — that is, when the obliquity attains to $35^{\circ} 25' 47''$ — the Arctic Circle will have crept down towards the equator in both hemispheres twelve degrees, which will thus cause the tropics to extend to the same amount towards the poles, and so extend the tropical zone from Cape Hatteras to the River Plate.

Under such conditions the human mind fails to conceive the vast changes which must be brought about during every six months from the mighty floods caused by the intense summer heat and the intense cold of the Arctic winter, alternating with each other.

It is to such changes of temperature that we find the remains of Arctic and tropical animals imbedded together in the same

drift in their migrations towards those latitudes which their natures demanded, and so must man move in accordance with the necessities of the time as regards temperature and its consequences.

It is calculated that we are about 403 years distant from the time when the pole of the heavens in its revolution, the pole of the ecliptic, and that of the second rotation will be in the same colure—that is, in the year 2295 A.D.; and then the least differences in temperature between summer and winter will be experienced. From that time forward this difference will increase, and about 6,000 years later—or about the year 8300 A.D.—the earth will enter upon the next glacial period, and attain its greatest severity about the year 18,136 of our era; that is, when one half-revolution of the pole, occupying 15,841 years, will have been completed from the point indicated, of the pole and two centres being in the same colure.

The evidences of geology now attest the accuracy of this discovery, though twenty years later than it was discovered by this astronomer. Herschel, in his "Outlines of Astronomy," described the movement of the pole as describing a circle round the pole of the ecliptic as a centre and at a uniform distance from it of $23^{\circ} 28'$, though in another article he admitted a decrease of obliquity of $48'$ per century; and these two contradictory assertions appear to have been copied or misunderstood by astronomers and mathematicians for more than a hundred years. Twenty-five years ago General Drayson pointed out the error, but no attention was paid to this. Now, however, all who look for the truth will receive a fresh impetus to independent enquiry, and signs of a change are already appearing which nothing can arrest, substantiated as his calculations are by the observations of the last 2,000 years.

In concluding these remarks, it may be observed that the axis of the planet Uranus very nearly coincides with the plane of its orbit, which varies only about $46'$ from that of the earth, and astronomers, observing that its satellites moved in a contrary direction to that of the other planets, assumed that the satellites of Uranus "moved in opposition;" but General Drayson pointed out that this was not the case, and explained that it depended upon which pole of the planet was turned toward the earth which way the satellites would appear to revolve, whilst their real motion round the planet was not in opposition, but in conformity with the law that all satellites move round their primaries in the same direction.

It is possible that this discovery has never been suitably acknowledged by any scientific society, but in a work published in 1862, viz., "Common Sights in the Heavens," General Drayson, at pages 172 to 175, pointed out that former writers on astronomy had been in error in attributing to the satellites of Uranus a movement different from that of any others in the system. His geometrical proof of this fact is very simple, and it seems surprising, when we see the solution of the mystery, that writer after writer on astronomy should have copied each others' mistakes for more than seventy years.

Lastly, it is to be hoped that the discoverer of the second rotation may live to see the triumph which he has achieved universally admitted by all true lovers of science.

ALABAMA BAUXITE.¹

BY HENRY MCCALLEY, UNIVERSITY, ALA.

BAUXITE was first discovered in Alabama in 1889. The first discovery was at the Dykes Limonite Banks, Cherokee County. Since then it has been found at the Walker Limonite Banks, near Jacksonville, Calhoun County, and at the Laney Old Manganese Banks, Cleburn County.² These deposits are all in the lower part of the Lower Silurian. The Cherokee and Calhoun deposits are at the bottom of the Knox Dolomite of Safford of Tennessee, now believed to be Upper Cambrian. The Cleburn deposit is in the upper part of the Weizner Quartzites, Middle Cambrian, believed

to be identical with the Chilowee Sandstone of Safford. They are all in sections of country that are badly broken up by sharp folds and great thrust faults, and in which the characters of the rocks have been greatly changed, doubtless by the great heat produced in their folding and faulting. They are all pocket deposits, though they occur along regular leads and show more or less stratification in all of the cuts that have been made upon them. They occur about as do the limonite and clays with which they are closely associated, though they appear to show more evidences of stratification. They are so closely associated with the limonite and clays that their deposits appear to be greatest where the limonite and clay deposits are greatest.

The Cherokee deposits appear to occur along the crest of two sharp parallel anticlinals covered by *débris*, that run in a general north-east and south-west course and are from 150 to 200 yards apart. Between these anticlinals is a sharp synclinal, and it is more than probable that some of the bauxite deposits of the opposite anticlinals, as irregular stratified seams, are connected or are continuous, under the surface, across the synclinal trough. The largest limonite and clay deposits of this immediate section are in the synclinal trough, and it is believed that future developments will show the largest bauxite deposits to be also in the trough. The bauxite, in places at least, is on the top of a friable sandstone and under or in the lower part of an unctuous clay. The limonite is usually on the top or in the lower part of this unctuous clay. In places, however, there is bauxite seemingly on the top of the limonite, and in still other places it occurs in the clay as large masses and as small nodular concretions.

The Calhoun deposits, in the few shallow cuts that have been made upon them, also appear to be on the top of a sharp anticlinal. The Cleburn deposit has never been dug into and shows only as a few loose boulders on the surface.

The Alabama bauxites have not as yet been dug into sufficiently to enable even a rough approximate estimate to be formed as to their quantity, still enough has been done on the Cherokee deposits to show that they alone have in them an immense amount of ore. They show on the dip in limonite old diggings to the depth of 75 feet. In one limonite old digging, the Dykes Bank proper, the bauxite, as an irregular seam about 60 feet thick, shows from the top to the bottom of the digging about 75 feet deep. This is the only place in which the full thickness is shown, though in half a dozen other places from a few feet to 50 feet in thickness it can be seen. It has been seen by the writer at intervals on both of the anticlinals for a distance of about one and a half miles, and it is said to show at intervals on both anticlinals for a distance of nearly five miles.

The Calhoun deposits show at intervals in a north-north-east and south south-west course for about 250 yards. They have not been dug into sufficiently to show either the thickness or even the quality of their ore. In one of the pits or trenches, however, a thickness of about 25 feet of ore can be seen.

The Alabama bauxites are mostly concretionary or pisolitic, though some of them are earthy or clay-like. The eyes or concretions are usually of the size of a small pea, though sometimes they get to be irregular concretionary nodules of some two inches in diameter. The earthy or clay-like variety has often a metallic ring. The Alabama bauxites are of white, red, and gray colors.

The Cherokee bauxite, in car-load samples as sent to the manufacturers, is said by Mr. J. M. Garvin, superintendent of the Bass Furnace Company, Rock Run, Ala., to have about the following approximate analysis:—

Alumina, from	50 per cent to 60	per cent.
Ferric oxide, about	2.75	per cent.
Water, from	25 per cent to 30	per cent.
Insoluble matter, principally silica, about	7	per cent.
Titanic acid, from	2 per cent to 3	per cent.

This analysis shows the Cherokee ores to be of very fine quality. They carry, as said by the manufacturers, a somewhat smaller percentage of alumina than do the Baux, or France, ores with which they come in competition, but that they are more soluble, and hence are more valuable.

¹ An abstract of a paper prepared for the Fall Meeting, on Nov. 16, of the Alabama Industrial and Scientific Society.

² Since the above was written, it has been heard that Bauxite out-croppings have been found in two other places in Calhoun County, near Anniston.

Up to date only about 5,000 tons of bauxite has ever been shipped from Alabama. It has gone to Philadelphia and Natrona, Penn., and to Syracuse, Buffalo, and Brooklyn, N. Y., and to other places. It has been used principally for the manufacture of alum by the sulphuric acid method. The Alabama ores cannot be laid down in the above markets as cheaply as the Baux ores, and hence, if it was not for their superiority, they could not compete at all with the Baux ores. As it is, the profits are said to be small, and so it is not likely that the bauxite industry of Alabama will become very great until a home market is created for the ore. This, it is hoped, will soon be the case, as an aluminum plant is said to be now under way near Rome, Ga.

THE INTRODUCTION OF FOREIGN SPECIES.

BY JOHN GIFFORD.

NATURE maintains an equilibrium, and when this is interfered with by man evils ensue which are even more serious than the one he attempts to obviate. No man can predict the results of the introduction of an exotic animal or plant. Such a step should be attended with more study and caution than are usually exercised. One animal preys upon another to such an extent that by the introduction of other species the damage indirectly done is much more real than apparent.

When the cultivation of cane and the manufacture of sugar, molasses, and rum were at the height of their glory, the plantations of Jamaica were infested by rats. In order to rid the island of this pest the mongoose was introduced from India. In spite of the damage done to some of the domestic animals of the small property owners, the result was on the whole at first beneficial, since the prosperity of the island depended upon the products of the large plantations. Times changed, and the sugar industry faded. The negroes now have their own patches, and being favored by an indulgent Nature, with low ambitions and few wants, are forced to keep dogs to protect their poultry. They feel the loss of a pullet more than ever before. This class of people constitutes more than half the population. The mongoose has been increasing, and other small animals in consequence decreasing. Snakes are now extremely scarce, and many of the birds which nest on the ground have been destroyed. This animal inhabits both the lowlands and mountains, so that rats and mice take refuge in banana bunches, where they often build their nests. But these are only the direct consequences. Animals upon which this animal preyed fed upon other animals, especially insects. These have increased accordingly. Tics, for instance, which they say were introduced on South American cattle, have become an awful pest. There was no enemy to subject them, and only those who have walked through the beautiful pastures of this island, shaded with pimento and ceiba trees, can judge of their abundance. In crossing a pasture your legs become covered with these parasites, which, unless removed at once, bury in the flesh and cause much pain. While botanizing in the region of Mandeville, in the mountains, after each excursion the writer was forced to undergo a tedious operation: it was to have these tics picked out of the skin by negro boys, who have become expert by long practice, and many are the sixpences they have thus earned.

Out of revenge the Indians introduced the fer-de-lance, the ugliest and deadliest of reptiles, into Martinique and other West Indian islands. This snake increases rapidly in numbers, and many are its victims yearly. By the thickness of its skin the pig, and by its agility the cat, alone withstand this animal. Thus what they failed to do in war the Indians accomplished by a peculiar stratagem.

The abominable life-plant was introduced, perhaps as a curiosity, into certain parts of the West Indies. It has become a troublesome weed. It is impossible to combat or exterminate it. It grows in spite of you. Cut it up as you like, and it will sprout. Pull it up and hang it in a dry place or put it in your pocket, and from every indentation on the edges of its leaves there will come a sprout.

Every visitor to Nassau knows of the Giant Ceiba, with its far-reaching branches and curious buttresses on the public plaza.

This was planted by John Miller, and its history is of interest in showing how accidentally and rapidly the introduction of a species may be effected. He was a sea-captain, and traded to Brazil. He admired the ceibas so much that he brought home a seed or sprout to plant in his garden in one of our southern cities. He was a Loyalist; and when the War of the Revolution began he went to Nassau with his ceiba tree. This is the tree to which I refer — a tree many times photographed and described, the object of much admiration and the pride of Nassau. From the seeds of this others have come until now it is one of the commonest trees of the Bahamas. Thus animals and plants of benefit and detriment to a country have been almost everywhere accidentally introduced. In spite of warnings, grape-cuttings were introduced from America into Europe, and with them went the diseases of our vine with serious consequences. No matter how beneficial the introduction of a foreign species may at first appear, a sort of quarantine should be established, the government alone taking it in hand, introducing species only, after much study, with much caution.

New Orleans, Nov. 5.

PALÆOLITHIC MAN IN THE SOUTHERN PORTION OF THE DELAWARE VALLEY.

BY DR. HILBORNE T. CRESSON, PHILADELPHIA, PENN.

THE revival of the old feud in regard to palæolithic man is certainly a most interesting one, and I fully concur with my friend, Professor G. Frederick Wright, that "full discussion will dispel the uncertainty that may exist."

A great deal has been said about the finds in the Wilmington gravels (Columbian of McGee), and I notice that for some inexplicable reason the finds of others than myself have been ignored. I will give, presently, a brief *résumé* of the finds in supposed Columbian deposits, but before doing so it may be well to explain that I am not a professed geologist, but I do claim to have had the opportunity, by reason of a residence of twenty years in the vicinity of Wilmington, to study the aqueous deposits in that vicinity, and at times, in company with those who are authorities upon the subject. I take pleasure in quoting the names of Professors McGee and Wright and the late Professor Lewis. Messrs. McGee and Wright visited the Wilmington gravels at my request, and the former gentleman was accompanied by so distinguished an archaeologist as Mr. W. H. Holmes of the U. S. Bureau of Ethnology. It was my good fortune to meet Professor Lewis at Claymont, during visits that he made to relatives who lived in a property adjoining my father's, and in these, our youthful days, we made many excursions over the gravels and brick clays which now bear his name. As Dr. Abbott suggests, in a recent publication in *Science*, "When I find gravel stratified and unstratified, I know and assert the difference," and it may be suggested, without conceit, that those who have spent years in studying glacial deposits, and searching among them for evidences of primitive man, aided at times by suggestions from the full-fledged geologist, ought to have some slight development of the perceptive faculty, in this respect, and be able to judge whether the condition of the gravels, in question, was disturbed or undisturbed, as the case may be.

During Professor McGee's visit to the Wilmington gravels (I have designated them thus, as Carpenter Station, on the Baltimore & Ohio Railroad, is but a few miles distant from this place), Mr. Holmes found what is now called, at the Peabody Museum, Harvard University, "the Holmes Palæolith." It is a piece of white quartz, bearing, according to the opinion of Professor Putnam, Dr. Abbott, Professor Wright, and Professor Wilson, evidences of artificial fracture. When the quartz in question was found by Mr. Holmes, I requested Professor McGee to examine the place from which it had been taken. He pronounced it to have been found in undisturbed Columbian deposits, but I here call especial attention to the fact that neither Holmes nor McGee deem the implement in question to be artificial. The palæolith was then submitted to Dr. D. G. Brinton for examination, who also condemned it. There is this to be said, however, that when

Mr. Holmes picked the implement out of a bank, among hundreds of other pebbles which surrounded it, he was attracted by its resemblance to a palæolith. If I recall our conversation at the time correctly, Holmes stated that although he believed the quartz to be a natural form, it resembled somewhat such implements. Certainly, then, this discovery is entitled to due consideration, for although the implement has been condemned by some, has it not received the approval of others who are also authorities upon the subject, among them Professors Putnam, Wright, Wilson, and Dr. Abbott.

Palæoliths have been found in the Columbian gravels at Trenton by Dr. Abbott and his son, Richard Abbott, according to the labels attached to the specimens preserved at the Peabody Museum, and presented by these gentlemen to that institution.

Two other palæoliths have been found in the Wilmington gravels by different gentlemen and are now in the Peabody Museum, Harvard University, together with the letters accompanying them. It has been suggested that they have been found in a talus. Whether this be so or not remains to be determined. I, some time ago, called attention to the fact that the old aqueous deposits in the vicinity of Wilmington have evidently been subjected to considerable disturbance (see remarks on a "Fallen Forest and Peat Layer," Bull. of Geol. Soc. Am., Vol. II.), and it may be that this took place in times comparatively recent. In fact there is a probability that this may have been even after "the ancient talus" at Trenton was deposited. I am predisposed to this opinion from the fact that during the extraction of clay from the pits at Richmond's brickyard (mouth of Naaman's Creek) leaves of oak and sycamore trees were found beneath the brick clays of Lewis, and in other portions of these excavations the more ancient and recent gravels were intermingled together among the fallen forest layers.

Implements have been found in the brick-clays just mentioned, and these are at the Peabody Museum with the records of the donors attached.

Looking over the list of finds in supposed tertiary and post-tertiary deposits, it appears that some class all of these as neolithic implements, that is, judging by the character of the implements themselves. May it not be queried, is the neolithic classification of European countries applicable to certain finds on our western continent? for it seems that some of our ancient deposits contain the handiwork of neolithic man. The antiquity of certain deposits which seem to have yielded in the majority of cases implements claimed to be of neolithic type is a question for the geologist to decide, until then arguments upon this subject have but little weight. Still, as we said in the beginning of this article, they are interesting; and, we may add, allow all concerned to express their opinions.

LETTERS TO THE EDITOR.

*** Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

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Natural Implements.

THERE are some things suggested by Dr. Brinton's recent article relating to early man in America, and three quotations may be made bearing on the subject of supposed primitive human art. It may be premised that no working archæologist has failed to find things of a puzzling character, those which he hesitates to retain as being of human workmanship, and yet which he is not altogether willing to cast aside. He accepts the fact, also, that many articles were so nearly fitted for man's use naturally that he often used them just as they were found.

An article, entitled "Observations on Stone-Chipping," by George E. Sellers of Illinois, prepared at Dr. Rau's request, was published in the Smithsonian Report for 1885, and is well worth reading. The various artificial processes are described, and some of the natural ones. He says: "The river-drift or gravel bars,

when subjected to the grinding and crushing action of drift-logs or rolling boulders, would furnish many suggestive forms and shapes that a little ingenuity would apply, and out of which would naturally grow the art of flaking. The streets of Paducah, Ky., are paved with partly rounded, angular, silicious gravel, mostly of jasper. Seeing heaps of this ready for spreading, I was struck by the many forms, mostly highly water-polished, that if found on a flaking ground would pass for refuse flakes and rubbish left by the workmen. On inquiry, I was informed that this coarse gravel was from banks on the Tennessee River, above the ordinary overflows. I selected many forms that any archæologist would pronounce to be the work of man."

He observed that a heavy wagon, driven over these, produced no effect on the surface gravel, but did on those lower down. "Many of the fresh fractures presented the form and appearance of genuine cores, and would be mistaken for the work of man." This led him to make an experiment by pressure, in a vessel. "On emptying the cylinder, the result was many representations of the rude implements found in the drift."

The second quotation is from a paper read by Dr. D. S. Kellogg of Plattsburgh, N. Y., at the New York meeting of the American Association for the Advancement of Science, in 1887, and entitled "Aboriginal Dwelling Sites in the Champlain Valley." "The material of which the chipped implements were made is found throughout this whole region. The so-called flint is abundant in the limestone of the locality. On Butler's Island in Lake Champlain detached pieces of the dark and striated flint, a foot or more in diameter, are so driven against each other by the action of the waves that their surfaces resemble the roughened surfaces of ordinary flint hammers."

The third quotation relates to the same lake, and will be found in the "Jesuit Relation" of 1668. The French had come within two miles of the Ticonderoga River. "Here we halted, without knowing why, until we observed our savages gathering from the shore pieces of flint, nearly all cut in shape." Then follows an Indian superstition connected with this customary gathering. "The occasion for this ridiculous story is the fact that the lake is often swept by severe storms, which cause high waves, particularly in the bay where Sieur Corlart, of whom we have spoken, perished, and when the wind comes from across the lake it casts upon the shore quantities of flint ready to strike fire."

There is one supposed trace of early man in New York that seems injudiciously used. Near the summit of the Lake Ridge, in the town of Gaines, was a spring, and in sinking a well on the spot traces of fire were found at the depth of eighteen feet. It is assumed that a fire was built on the beach when the lake was receding, and that it was buried in some way by the waters below it, under nearly twenty feet of soil. How this curious geological action was brought about is not explained. To produce such a deposit the waters should have risen above the fire, not fallen away from it. The probable solution might be that a fire was built in a ravine by a stream; that the ravine was filled in, turning the stream into a spring; and that other natural processes followed. That the lake could have buried the fireplace thus deep is clearly impossible. The depth by itself, however, is nothing very rare; but a field archæologist soon learns to distrust evidence of this nature. In some cases known to the writer, early villages and lodges, standing on open ground exposed to the wind, were buried in the sand, and the forest grew over them. The forest was cleared away all around, and the wind, with a wider sweep, carried the sand away again.

W. M. BEAUCHAMP.

Baldwinsville, Nov. 4.

Jealousy of a Dog.

IN an article in *Science* of Oct. 28, Mr. Stevenson remarks upon the jealousy of infants. Would you not place an infant of ten months upon a higher standard of development than a dog? Yet dogs are jealous. My brother owned one, a well-grown, bright fellow, who was usually upon excellent terms with my kitten but showed jealousy if the kitten was petted in his presence. On one occasion I held the kitten in my arms and pur-

posely patted and praised it while the dog's eyes kindled ominously at the pretended neglect of himself. Suddenly the kitten jumped from my arms to the floor, and before I could interfere the dog had seized and shaken its little life out of it. I mention this as simply an instance. I believe that even birds show jealousy and sulk if too much notice is given a mate or a rival.

L. L. H.

BOOK-REVIEWS.

A Treatise on Plane and Spherical Trigonometry. By EDWARD A. BOWSER, LL.D. Boston, D. C. Heath & Co., 1892.

THE different treatises in Dr. Bowser's series of text-books are all characterized by an abundance of well-selected exercises. For class-room use this is a commendable feature. The accompanying texts, however, are often open to some criticism; they partake too much of the nature of compilations. It can be asserted that all such works are compilations to a greater or less extent, but such a claim is not always just. An author may go over the whole ground, making himself thoroughly familiar with his subject, then condense his materials, classify carefully, present in a comprehensive manner, allowing himself to be governed in all this work by well-known pedagogical principles. Against a text-book prepared in this way this charge could not, in justice, be brought. In a prospectus issued along with the trigonometry, his publishers state that Dr. Bowser is accustomed to bring out, on the average, one new volume a year. Whether such a feat is a matter of pride on the part of the publisher or the author does not appear. At any rate, it furnishes an explanation of the weakness as well as the strength of the series.

As a general rule, a presentation of a science which varies greatly from the historic development is likely to be more difficult to master than one which does not. Some authors of trigonometries actually reverse the natural order. If the student could commence just where Hipparchus commenced, with the relation

between arcs and chords, and be shown the advantage in the use of a table of chords, and then led from that to a table of sines and thence to the other functions, the subject would be learned in its true bearing from the start. It is true trigonometry was for centuries regarded merely as an introduction to astronomy, the result being that the spherical part was developed abnormally. But from the days of Regiomontanus (Cantor, II., p. 242) it was studied as an independent science and grew accordingly. As topics in a natural treatment of plane trigonometry we might have: Arcs and chords; chords and sines; sines and the other functions; these functions in the solution of right triangles, exercises; solution of oblique triangles by dropping perpendiculars, exercises. Principle of continuity; angles and functions in other quadrants; fundamental relations between the functions; derived relations. Addition and subtraction formulæ, including all formulæ which are easy consequences. Cases in the solution of oblique triangles, with exercises, deriving appropriate formulæ as needed. Logarithms; solution of triangles by logarithms, model arrangements, exercises. Solution of trigonometrical equations, De Moivre's theorem, and such other topics as it may be thought best to insert. It is a grave pedagogical mistake not to use the natural tables first, and until the student is made to feel the need of some labor-saving system. The use of the functions and the use of the logarithms are entirely distinct, and should be well separated from each other in the mind of the beginner. The natural tables were calculated to fifteen decimal places the century before Napier invented his logarithms. To sum up in one sentence, there should be more of historical evolution in the presentation of trigonometry.

Let us test the plane portion of the present work by the principles suggested. After giving the ratio definitions of the functions first, the student is plunged into the generalized conception of arcs and functions. Next the addition formulæ are given and all their corollaries, which means a considerable part of theoretical trigonometry. Next, logarithms and the log-function tables are

CALENDAR OF SOCIETIES.

Chemical Society, Washington.

Nov. 10.—F. P. Dewey, Crystallized Sulphite of Zinc; W. D. Bigelow, On the Viscosity of Sorghum Juices. Mr. Dewey's paper first reviewed the literatures of sulphite of zinc from Berthollet (1789) to Deniges (1892), showing that most of the early investigations were occupied with the complex action of SO_2 on metals, in which the production and examination of sulphite of zinc was merely an incident, and while some had produced the sulphite by the direct union of ZnO and SO_2 , only a few had produced it by double decomposition. Two formulæ have been announced. The first $\text{ZnSO}_3 \cdot 2\text{H}_2\text{O}$ was proposed by both Muspratt and Forclos and Gelis in 1843, upon meagre analytical data, followed, in 1844, by Dr. Koene with quite satisfactory results. In 1845, Rammelsburg announced the formula as $2\text{ZnSO}_3 \cdot 5\text{H}_2\text{O}$, which was supported by Marignac, in 1857, in an elaborate and complete examination. Finally, in 1892, Deniges somewhat arbitrarily announced that the formula must be $2\text{ZnSO}_3 \cdot 5\text{H}_2\text{O}$. Mr. Dewey's first results, which were all obtained by dissolving ZnO in SO_2 water, clearly and unmistakably supported the earlier (1-2) formula, but, on repeating Denige's work, the later formula (2-5) was obtained. Finally, from the same solution of ZnO in SO_2 water, both salts were obtained. By allowing the SO_2 to go off slowly, a crop of small, powdery crystals was obtained, showing the 2-5 formula.

The mother-liquor from this salt was heated to drive off SO_2 quickly, when quite large and distinct crystals were obtained, which gave the 1-2 formula, thus showing that the salt crystallizes with two proportions of water, and that both formulas are correct. It was also found that sulphite of zinc heated with free access of air is completely decomposed and yields an oxide carrying less than 0.01 per cent of sulphur. W. D. Bigelow read a paper on the Viscosity of Sorghum Juices. About one hundred juices of different specific gravity were taken and the amount delivered by a 50 cubic centimeter pipette was carefully weighed. This was deducted from the true weight of 50 cubic centimeters of the juice and the result taken as loss due to viscosity. From this it was estimated that a 50-cubic centimeter pipette would deliver from 49.5 to 49.9 cubic centimeters of the juice. It was also noticed that the most varying results were obtained from different juices of the same specific gravity.

Biological Society, Washington.

Nov. 19.—Theobald Smith, On Certain Minute (Parasitic?) Bodies within the Red Blood Corpuscles; C. W. Stiles, The Topographical Relations of the Excretory Canals of Cestodes; David White, A Walchia from New Mexico; F. M. Webster, Some Entomological Factors in the Problem of Country Fences; F. V. Coville, Comparative Value of Plants in Determining Floral Zones.

Appalachian Mountain Club, Boston.

Nov. 9.—John Ritchie, Jr., The State Park on Temple Mountain, N.H.; John Coleman Adams, The Brook Path up Chocorua.

Reading Matter Notices.

Ripans Tabules: best liver tonic.
Ripans Tabules cure jaundice.

RACES AND PEOPLES.

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explained. Chapter V. treats of the solution of trigonometrical equations. Then the formulæ for the solution of right and oblique triangles are given in full, and a lot of theorems on inscribed and escribed circles with a large number of exercises. Finally, on page 166, the first right triangle is solved, by logarithms of course! Then follow the other cases in the solution of triangles.

The last two chapters of the plane trigonometry treat very properly of the construction of trigonometric tables and De Moivre's theorem. In a foot-note, De Moivre is called a French geometer. It is true he was born in France, but he should rather be styled an English mathematician. In another note (page 91), speaking of the Napierian system, the author says it is so called from the inventor, Baron Napier. He should have said it is so called *in honor* of the inventor of logarithms. He gives the date of the introduction of Briggsian logarithms as 1615. They were suggested to Briggs in 1615, or about that time, but they could not be said to have been introduced until two years later. It is odd that in such a small number of historical references the author should have contrived to make so many mistakes. He calls arc sin, etc., the French, when he might have described it as the continental notation. Referring to addition and subtraction logarithms, he names only J. Zech, Berlin, as compiler of such tables. One would expect reference to Gauss, if to any one. There are numerous minor points which are quite worthy of commendation, but, on the whole, in the writer's opinion, the trigonometry is not nearly as satisfactory as other volumes in the series.

AMONG THE PUBLISHERS.

THE Open Court Publishing Co. will issue for the holidays "Truth in Fiction, Twelve Tales with a Moral," by Paul Carus.

Besides the serials which begin in the November and December numbers of the magazine, *The Century* has in preparation for the ensuing year many other important features, only a few of

which can be mentioned here. "Good Roads" will be one of the subjects, the important matters of street-paving and railroad-crossings being treated by men well qualified to discuss the questions. Papers on educational institutions and methods in America are in preparation.

The December *Atlantic* will contain a description of being "Alone on Chocorua at Night," by Frank Bolles, author of "Land of the Lingering Snow."

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With the number for November, 1892, *The Century Magazine* began a new volume. In November is also given the first instalment of "The Letters of Two Brothers." This series consists of extracts from letters which passed between the late General Sherman and his brother, Senator Sherman, at critical periods in American History, and are edited by General Sherman's daughter. Other serials beginning in this number are on "Science and the Bible;" the first paper, "Does the Bible Contain Scientific Errors?" being by Professor Shields of Princeton; to be followed by "The Effect of Scientific Study upon Religious Beliefs." The December *Century* will be a thorough-going Christmas number, full of Christmas stories, Christmas poems, etc., and with many full-page and other illustrations.

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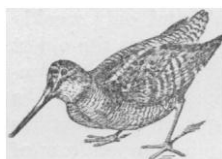
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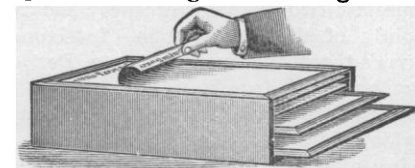
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